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13. ABSTRACT (Maximum 200 words) <i>Blepharisma japonicum</i> and <i>Stentor coeruleus</i> , single cell protozoan ciliates, possess both light intensity- and wavelength-sensitivity. Their light sensor molecules, blepharismine and stentorin, respectively, contain hypericin-derived structures as unique photoreceptor chromophores. Under this grant, we recently elucidated the chemical structures of both blepharismine and stentorin. How these light sensor molecules mediate the intensity- and wavelength-sensitive light-sensory responses in these single cell organisms is still under investigation in this laboratory, results so far strongly suggest that both blepharismine and stentorin initiate their primary photoprocesses via electron transfer.				
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# **Photo-Signal Transduction in Motile Cilia Blepharisma**

## **FINAL PROGRESS REPORT**

**Pill-Soon Song**

**U.S. ARMY RESEARCH OFFICE**

**Funding Number: DAAL03-92-G-0356**

**University of Nebraska-Lincoln  
Department of Chemistry**

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Specific aims of the study were to elucidate: (a) the chemical structures of light-sensor molecules blepharismine and stentorin, and (b) their mechanisms of action in light-sensory signal processing events, namely, detection of sudden changes in light intensity and light-avoiding behaviors of the single cell ciliate *Blepharisma japonicum* and its closely related organism *Stentor coeruleus*.

During the period of this grant, two significant results have been achieved. For the first time, we have been able to isolate and purify the photosensor-bound protein, stentorin, with molecular weight of 55,000. This light-sensor protein retains the functional characteristics of native stentorin protein complex of more than half a million molecular weight located within the pigment granules of *Stentor coeruleus*. In addition, we have been able to determine a tentative chemical structure for the light sensor chromophore of *Blepharisma japonicum*. It appears that the chemical structure of blepharismine is distinctly different from that of stentorin. Both stentorin and blepharismine add to the exclusive list of only a limited number (four to five) of light sensor molecules in nature.

Light signals perceived by the single cell ciliates are transduced by transducin-like G-proteins, as suggested by our study of the effects of various G-protein activators and inhibitors on the photo-sensory responses of both organisms. To characterize the G-proteins in the ciliate cells, Phun Bum Park and Elisabetta Bini supported by this grant partially cloned and sequenced Blepharisma and Stentor G-proteins. Photo-activation of G-proteins appears to be coupled to a cGMP-dependent phosphodiesterase. If this result is further confirmed by directly isolating and/or cloning the latter and establishing its light activation via G-proteins, the single cell photo-signal transduction system will provide an interesting comparison to the visual excitation system in mammals.

- (1) LIST OF MANUSCRIPTS published under ARO sponsorship during this grant period (includes publications arising from both DAAL03-92-G-0356 and 28748-LS-SM with identical project title):
1. N. Tao, M. Orlando, J.-S. Hyon, M. Gross and **Pill-Soon Song**, A New Photoreceptor Molecule from *Stentor coeruleus*. J. Am. Chem. Soc. **115**, 2526-2528 (1993).
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14. N. Tao, L. Deforce, M. Romanowski, S. Meza-Keuthen, **Pill-Soon Song**, and M. Furuya, *Stentor* and *Blepharisma* Photoreceptors: Structure and Function, Acta Protozool. **33**, 199-211 (1994).
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16. J. L. Wynn, J.-H. Kim, N. Tao, R. Dai, **Pill-Soon Song**, and T. M. Cotton. Characterization of the photoreceptor of *Stentor coeruleus* by surface-enhanced resonance Raman scattering spectroscopy. J. Phys. Chem. **99**: 2208-2213 (1995).